# Adaptive Predictive Coding of Ultrasound Images

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Ultrasonic imaging has become an important modality in the field of medical imaging systems, making necessary to develop an efficient method to compress and store these images, while retaining the image fidelity. We present a lossless compression approach which exploits the particular characteristics of the ultrasound echo-cardiographic instrumentation based on a predictive adaptive coding method for compression [?].

The philosophy underlying predictive coding techniques is to remove mutual redundancy between successive pixels and to transmit only the remaining (uncorrelated) information. This information is essentially the error resulting from the prediction, which leads to a lower variance of the residual information than with JPEG method. The residual information is then entropy coded in order to achieve higher compression without further loss [?].

A set of pixels is chosen for the linear prediction model, taking into account the interpolation method used in the scan conversion process [?]. The prediction is performed by fitting a polynomial to the values of the neighboring pixels. The original value of the pixel is then subtracted from the predicted one. The error (for each pixel $i$) is defined as:

$$e[i] = x[i] - x'[i], \tag{1}$$

where $x'[i]$ is the predicted value calculated as:

$$x'[i] \;=\; \sum_{j=1}^{j=N} f[j]x[i-j] \quad \text{(with } N \text{ : order of prediction)}. \tag{2}$$

For each one of the predicted pixels the coefficients of the filter, $f[j]$, are adaptively calculated by minimizing the error. Since the used prediction algorithm is known to the decoder, there is no need to transmit the coefficients, which are computed 'on the fly' during the decoding process.

The algorithm has been applied to ultrasound echo-cardiography images, of size 720x576 pixels. The results are compared to the JPEG lossless compression method. The performance of the proposed scheme can be seen within the numerical results: applying lossless JPEG a bit rate of 1.69 bits/pels is obtained for the best mode (out of seven); whereas with the predictive adaptive filter we achieve a bit rate of 1.16 bits/pels, meaning a gain of 31.3%.

## REFERENCES

1. Peter M. Clarkson, "Optimal and Adaptive Signal Processing", Proceeding of the IEEE, Vol. 67, No. 4, April 1979.
2. Roger J. Clarke, "Digital Compression of Still Images and Video". Academic Press. 1995.
3. Steven C. Leavitt, Barry F. Hunt and Hugh G. Larsen. "A scan Conversion Algorithm for Displaying Ultrasound images". Hewlett-Packard Journal, October 1983.